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MACROBENTHOS OF SIMMONS BAYOU AND AN ADJOINING RESIDENTIAL CANAL

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ABSTRACT Species composition, abundance and seasonal variations of benthic macroinvertebrates in Simmons Bayou, Mississippi, and an adjoining dead-end canal were investigated from July 1976 through June 1977. Cluster analysis of the data summed over five stations indicated four major time periods: July, August–November, December–February, and March–June. Polychaetes and oligochaetes were most abundant in the winter and spring, amphipods in the summer, and chironomids in the spring. Temporal changes in abundance of polychaetes, oligochaetes, and chironomids appeared to reflect seasonal reproductive cycles. The peak in amphipod density corresponded with dense growths of *Ruppia maritima*. Within the dead-end canal, poor water quality and reduced infaunal densities appeared to be limited to the deeper water behind the sill.

INTRODUCTION

In recent years the Mississippi Gulf Coast has experienced a rapid growth in human population. Accompanying this growth has been an increased demand for residential and recreational waterfront property. Because such property is in short supply, regulatory agencies have received increased numbers of requests for permits to dredge canals through marsh lands to provide open water access to one or more homesites. These proposed canals are usually dead ended.

Regulatory agencies require sound biological information to determine if the proposed alterations would be detrimental to the environment. For the coastal areas along the northeastern Gulf of Mexico this information is largely lacking. Available studies on coastal canals from the area (Paulson et al. 1974, Paulson and Pessoney 1975) concentrate on hydrology and plankton with the benthos given only cursory attention.

The purpose of this project was to study the bottom-dwelling macroinvertebrates in a dead-end residential canal and in the nearby natural waterways. Comparisons of species composition of macrobenthos from the natural waterway were made with that from the canal. Seasonal variations of the benthos from the area were also investigated.

AREA DESCRIPTION

The study site was located in Simmons Bayou, a part of the Davis Bayou system, which empties into the Mississippi Sound near the mouth of Biloxi Bay (Figure 1). Water movement in the study area resulted primarily from tidal action with some freshwater runoff occurring during periods of heavy rainfall. Five stations were established—two in a natural bayou, two in a dead-end canal, and one in a dredged area of Simmons Bayou. Benthic samples and hydrological data were collected 17 times at these five stations at intervals of 17 to 31 days, from July 1976 through June 1977.

Stations 1 and 2 were located in an unnamed natural bayou. This bayou meanders through a *Juncus* marsh and is connected to Simmons Bayou at both ends. Water depths at these stations ranged from 30 to 120 cm depending on the state of the tide and direction of the wind.

Stations 3 and 4 were located in a dredged dead-end canal. Permanent residences and small fishing camps border the west side and the south end of the canal. A small fringe area of marsh grasses and bushes borders the east bank. Water depth at the mouth was reduced by a sill. Station 3 was located near the upper end of the canal with water depths of 120 to 185 cm. Station 4 was located near the mouth of the canal on top of the sill in water depths of 30 to 120 cm.

Station 5 was located in a portion of Simmons Bayou which was dredged through the marsh about 15 years ago. The south bank is an upland area covered with pine trees and dense underbrush while the north bank borders a large marsh area. Samples were taken in water depths of 60 to 150 cm.

Samples at stations 1, 2, 3, and 4 were taken in mid-channel. At station 5, samples were taken along the north bank. At all stations the substrate was sandy mud with considerable organic detritus.

MATERIALS AND METHODS

Measurements of temperature and dissolved oxygen were made with a Yellow Springs Instrument Co. Model 57 oxygen meter. Salinities were measured with an American Optical Goldberg refractometer. Benthic samples were collected with a 15.3 x 15.3 cm Ekman grab mounted on a 1.5 m handle. A single bottom sample was collected at each station during each sampling period. The sediment was washed into a 0.52 mm screen with fresh water, the residue preserved with 10% formalin and stained with rose bengal. Benthic organisms were hand sorted from the screened residue under an illuminated magnifier, identified, counted, and stored in 70% ethanol. Cluster analyses, using the Bray-Curtis dissimilarity index and flexible sorting (Stephenson 1972), were used to compare stations to investigate temporal changes. The "cluster intensity coefficient" β was set at the now conventional value of -0.25 (Boesch 1973).

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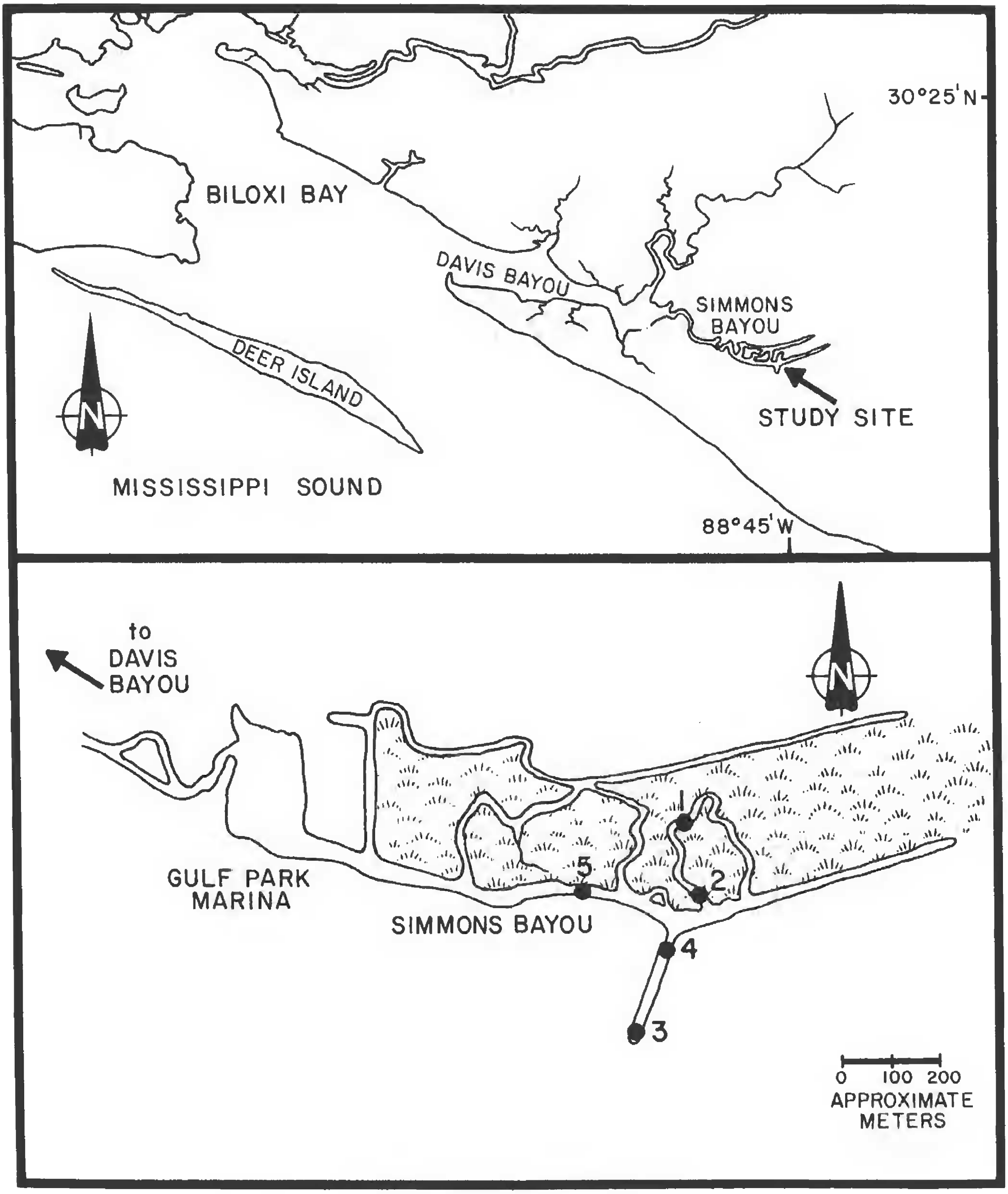

Figure 1. Area map and station locations.

RESULTS AND DISCUSSION

During the study 16,115 organisms representing 45 taxa were collected. Of these taxa, 34 were identified to genus or species level (Table 1). This list includes a saccoglossan, *Elysia chlorotica*, and a turbellarian, *Canatellia* sp., not previously reported from Mississippi. The range of the sabellid polychaete *Manayunkia speciosa* was extended to the Gulf of Mexico (Brehm 1978).

TABLE 1.

Benthic fauna found in Simmons Bayou and an adjacent dead-end canal.

Phylum Cnidaria		
	Class Hydrozoa	
		unidentified hydrozoan species
Phylum Platyhelminthes		
	Class Turbellaria	
		Canatellia sp.
Phylum Rhynchocoela		
	Class Anopla	
		Micrura leidyi (Verrill)
Phylum Mollusca		
	Class Gastropoda	
		Anadara sp.
		Elysia chlorotica (Agassiz)
		Hydrobiidae
		Neritina reclivata Say
		unidentified nudibranch species
	Class Bivalvia	
		Macoma mitchelli Dall
		Rangia cuneata Gray
		Tegula sp.
Phylum Annelida		
	Class Polychaeta	
		Capitella capitata (Fabricius)
		Eteone heteropoda Hartman
		Hypaniola floridana (Hartman)
		Laeonereis culveri (Webster)
		Lumbrineris coccinea (Renier)
		Manayunkia speciosa Leidy
		Mediomastus californiensis Hartman
		Parandalia americana Emerson & Fauchald
		Polydora ligni Webster
		Stenoninereis martini Wesenberg-Lund
		Streblospio benedicti Webster
	Class Oligochaeta	
		unidentified oligochaete species
	Class Hirudinea	
		unidentified hirudinid species
Phylum Arthropoda		
	Class Insecta	
		unidentified chaeoborine species
		unidentified chironomid species
		unidentified corixid species
	Class Crustacea	
		Almyracuma sp.
		Ampelisca abdita Mills
		Callinectes sapidus Rathbun
		Corophium louisianum Shoemaker
		Cyathura polita (Stimpson)
		Edotea montosa (Stimpson)
		Eurytemora sp.
		Gammarus mucronatus Say
		Grandidierella bonnieroides Stephensen
		Hargeria rapax (Harger)
		Macrocyclops sp.
		Melita nitida Smith
		Parametopella cypris (Holmes)
		Penaeus aztecus Ives
		unidentified harpacticoid species
		unidentified mysidacean species
		unidentified ostracod species

Hydrological Data

Bottom water temperatures, salinities, and dissolved oxygen concentrations at stations 1, 2, 4, and 5 were similar throughout the study (Figure 2). Although temperatures and salinities at station 3 approximated the other stations for eight months of the study, these parameters were appreciably higher at station 3 than at the other stations from November through March. During this period the salinities of the bottom water were as much as 13‰ higher than the surface readings and bottom water temperatures were up to 6°C warmer than the surface layers. This indicates that the water column at station 3 was stratified from November through March.

The dissolved oxygen concentrations of the bottom waters were always lower at station 3 than at the other stations (Figure 2). These differences were greatest from November through March when the water column was stratified.

Seasonal Effects

Cluster analysis of the species data summed over the five stations for each collection period indicated strong seasonality (Figure 3). There was a summer (July), a late summer-fall (August–November), a winter (December–February), and a spring period (March–June). Differences between the seasons were due to changes in abundance of polychaetes, oligochaetes, amphipods, and chironomids (Table 2). Polychaetes and oligochaetes were most numerous in the winter and spring, amphipods were most abundant in the summer, and chironomids exhibited their greatest density in the spring.

Temporal divisions noted in this study appeared to reflect changes in species composition associated with seasonal spawning cycles of benthic macroinvertebrates. The recruitment of large numbers of juveniles during the winter and spring indicated spawning occurred during the cooler months. Tenore (1972) attributed vast seasonal changes in species composition and density in the Pamlico River

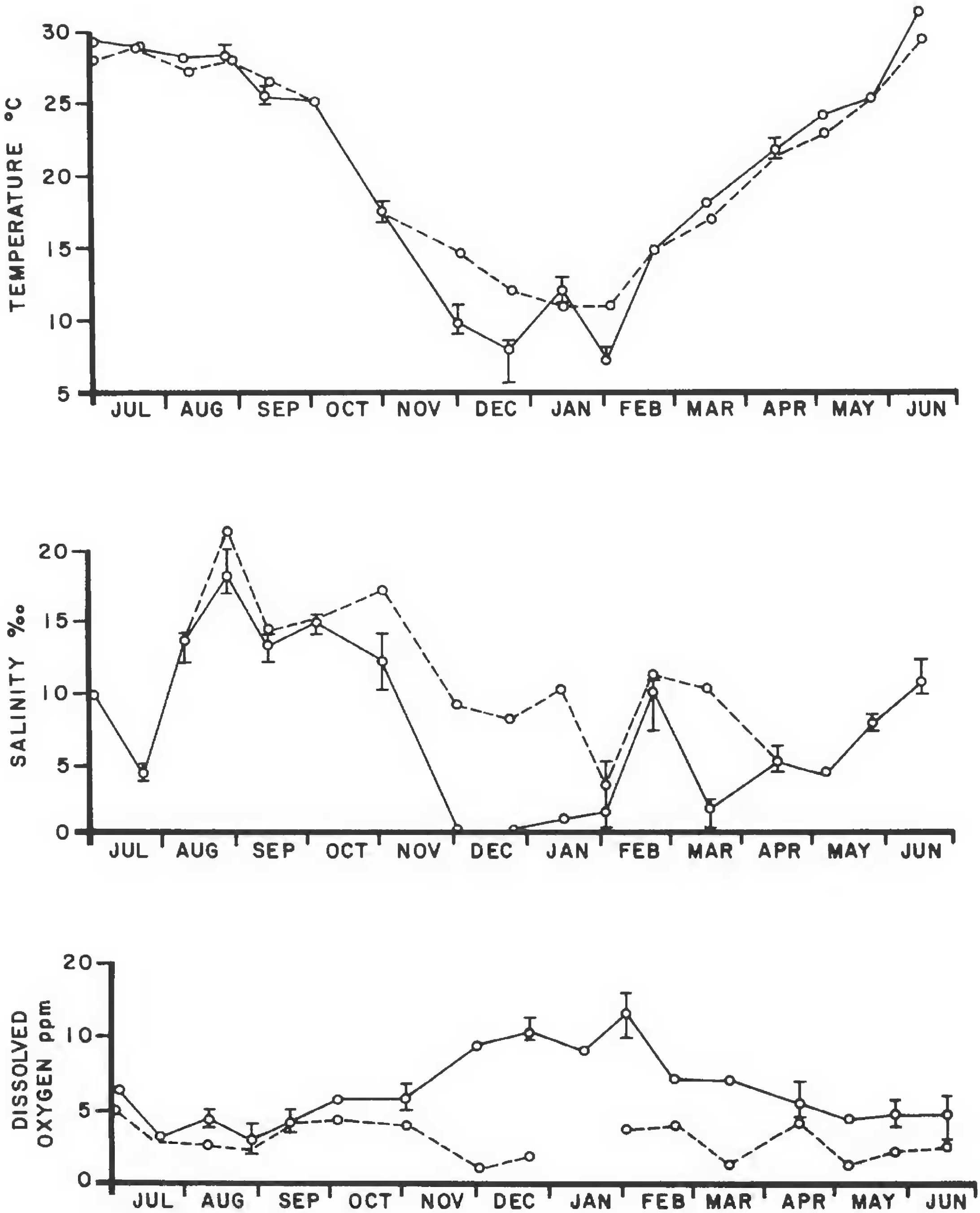

Figure 2. Bottom water temperature, salinity and dissolved oxygen in Simmons Bayou. Solid line represents mean and range of values for stations 1, 2, 4, and 5. Broken line represents station 3.

estuary to settling of juvenile forms during the fall and spring. Boesch (1973) reported that many species in Chesapeake Bay successfully spawn during both spring and fall, and others may be more successful only in one of the seasons. The data presented here indicate a pattern similar to the findings of Tenore (1972) and Boesch (1973).

The amphipods had their greatest recruitment during the cooler months but the abundance of these organisms in the summer appeared to be influenced by the amount of aquatic vegetation. During July dense growths of the submerged aquatic angiosperm *Ruppia maritima* were present throughout Simmons Bayou, especially at stations 1 and 2. The *Ruppia* died back in the fall and was not observed again during the study. Apparently this aquatic plant provided a favorable habitat for the amphipods, thus they were able to maintain high population densities (10419/m^2) through part of the summer. Amphipod abundance dropped drastically during the fall, along with the disappearance of the *Ruppia*.

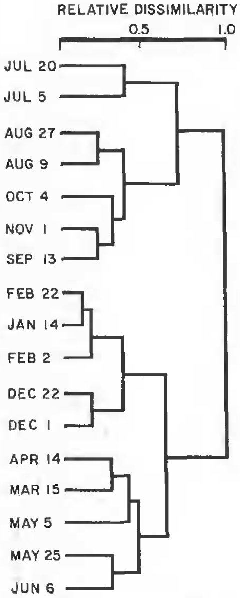

Figure 3. Clustering of combined stations by collection period using Bray-Curtis dissimilarity index and flexible sorting.

TABLE 2.

Mean density in individuals/m^2 of selected faunal groups during each season at Simmons Bayou.

	Summer 2 July– 20 July	Late summer– Fall 4 August– 1 November	Winter 1 December– 22 February	Spring 15 March– 16 June
Polychaetes	1,550	4,219	34,961	14,510
Oligochaetes	3,660	4,951	22,260	14,897
Amphipods	10,419	603	6,114	8,181
Chironomids	2,024	86	1,765	7,879

Station Differences

Cluster analysis of species data summed for all collections (Figure 4) indicated that stations 1, 2, 4, and 5 were relatively similar to each other and very dissimilar to station 3. This large degree of dissimilarity was due to the greatly reduced number of species and individuals at station 3. Total densities of the benthic infauna were relatively high for stations 1, 2, 4, and 5 and greatly reduced at station 3 (Table 3). In fact, during the entire sampling period only 140 individuals, representing 17 species, were collected at station 3. This compares with approximately 45 species and 4,000 individuals at each of the other stations.

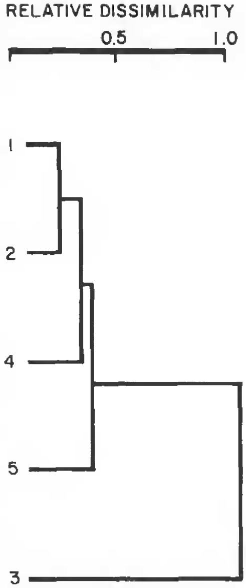

Figure 4. Clustering of combined collection periods by station using Bray-Curtis dissimilarity index and flexible sorting.

Biological studies of multibranched housing-development canals from other areas indicated that species composition and abundance of benthic organisms were detrimentally affected due to highly organic sediments and reduced water quality (Taylor and Saloman 1968, Barada and Partington 1972, Gilmore and Trent 1974, Lindall and Trent 1975). Although the canal system in this study was relatively short and unbranched, its overall effect appeared to be very similar to other canal systems. Densities of macroinvertebrates at station 3 were significantly lower (α = .01) than the other stations (Table 3). Although densities at all stations increased during the cooler months due to recruitment, this

TABLE 3.

Comparison of density, in organisms/m^2, of benthic macroinvertebrates of Simmons Bayou stations.

Date	Station 1	Station 2	Station 3	Station 4	Station 5
2 Jul 76	129	22,174	0	5,425	646
20 Jul	258	3,229	301	2,928	1,076
9 Aug	388	7,621	258	1,249	3,961
27 Aug	1,076	5,425	43	2,540	2,239
13 Sep	344	3,832	0	2,339	4,349
4 Oct	474	2,411	0	1,464	1,722
1 Nov	2,583	3,229	646	775	4,047
1 Dec	13,476	17,222	2,368	8,783	7,233
22 Dec	19,806	19,332	732	9,343	7,406
14 Jan 77	36,296	34,617	86	31,689	9,171
2 Feb	40,214	20,408	344	32,248	12,056
22 Feb	21,528	37,200	646	16,921	11,840
15 Mar	22,475	9,558	0	10,032	12,529
14 Apr	7,276	4,133	43	10,549	16,103
5 May	1,464	5,511	0	14,338	5,769
25 May	5,554	5,296	172	5,985	15,845
16 Jun	2,885	2,411	388	3,100	32,206

period coincided with stratification of the water column in the dead-end canal and total densities at station 3 never reached those of the other stations. Apparently the larvae were either unable to settle at station 3 due to the reduced circulation and stratification or they did not survive because of the low dissolved oxygen content of the water.

The area of poor water quality and reduced infaunal densities in the dead-end canal appeared to be limited to bottom areas behind the sill. Hydrographic measurements (Figure 2), infaunal densities (Table 3), and the results of the station clustering (Figure 4) indicated that the unfavorable environmental conditions observed at station 3 did not occur at station 4. This was apparently due to the sill across the mouth of the dead-end canal. The sill acted as a dam, restricting water circulation to the surface layers, and contributed to the stratification and stagnation of bottom waters behind it. Thus, station 4, located on top of the sill in the circulating layer, appeared to be unaffected while station 3, located behind the sill in deeper water, had the reduced faunal densities and hydrological characteristics described by Barada and Partington (1972) and Gilmore and Trent (1974) as being typical of dead-end canals.

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